

70/581256

5. Detailed Reply

(1) It is stated that claims 1-19 recited in the present application do not have novelty nor inventive step.

In reply to the opinion, the claims and the like of the present application have been amended in order to more clearly illustrate the features of the present invention. As the main aspects of the amendments, claim 1 is amended in order to add the features recited in the original claim 9, and claim 15 is amended in order to add the features recited in the original claim 1 as well as further features.

Please note, however, that the amendments have been made within the scope of protection for the original description and the like, and no new matter has been added. For example, the amendment of claim 15 has made based on page 16, lines 5-18 in the description, and the like.

(2) The application of the present invention discloses, as recited in claim 1, a method of performing plasma etching to an object made of silicon in a treatment chamber, which includes: introducing, into the treatment chamber, etching gas which includes fluorine compound gas and rare gas; energizing the etching gas into plasma state by supplying electricity to the etching gas, the electricity having a frequency that is equal to or more than 27 MHz; and etching the object using the plasma. By the above method, it is possible to achieve an effect of, by performing an etching process once, forming a trench having a high aspect ratio, without causing side etching in the trench.

On the other hand, document 1 discloses that, in paragraph [0017] of specification and FIG. 4, "a method of etching an object made of silicon by energizing, into plasma state, etching gas which includes SF<sub>6</sub> gas, O<sub>2</sub> gas, He gas, and Cl<sub>2</sub> gas".

Further, document 2 discloses that, in paragraph [0094] of specification, "high-frequency electricity (which is used to

energizing etching gas into plasma state) having a frequency from 50 kHz to 500 MHz can be used".

Still further, document 3 discloses that, in paragraphs [0008], [0019] and [0020] of specification, "a method of etching an object  
5 made of silicon by energizing, into plasma state, etching gas which includes SF<sub>6</sub> gas, CHF<sub>3</sub> gas, and Ar gas".

Still further, document 4 discloses that, in paragraphs [0064] to [0066] of specification and FIG. 7, "a method of etching an object made of silicon using etching gas which includes SF<sub>6</sub> gas, and then  
10 forming a protection film on a side wall using gas which includes C<sub>4</sub>F<sub>8</sub> as polymer forming gas".

Still further, document 5 discloses that, on page 3, line 11 - page 4, line 6; page 14, line 17 of description, "a method of etching an object made of silicon using gas which includes SF<sub>6</sub> gas, and C<sub>4</sub>F<sub>8</sub>  
15 gas as polymer forming gas".

Still further, document 6 discloses that, in paragraph [0098] of specification, "a method of etching an object made of silicon using etching gas which includes CF<sub>4</sub> gas and Ar gas".

However, documents 1 to 6 do not disclose or suggest that the  
20 etching gas is energized into plasma state, by supplying electricity having a frequency that is equal to or more than 27 MHz to etching gas which includes fluorine compound gas and rare gas, as disclosed in the application of the present invention. Therefore, it is submitted that the present invention has novelty.

Moreover, document 2 discloses that the etching gas is  
25 energized into plasma state, by supplying electricity having a frequency that is equal to or more than 27 MHz to etching gas, but does not disclose or suggest what kind of gas is applied with the electricity for the plasma energizing. The present invention,  
30 however, combines the feature regarding the etching gas including fluorine compound gas and rare gas with the feature regarding the electricity having a frequency that is equal to or more than 27 MHz,

in order to achieve an effect of significantly restraining occurrence of side etching, which is not disclosed in document 2. Therefore, it is submitted that the present invention has inventive step.

(3) The application of the present invention discloses, as recited  
5 in claim 15, a method of performing plasma etching to an object made of silicon in a treatment chamber, which includes: introducing, into the treatment chamber, etching gas which includes fluorine compound gas and rare gas; and etching the object by energizing the etching gas into plasma state, wherein the fluorine compound  
10 gas is  $\text{CF}_4$  gas, and increasing accuracy of an etching depth by lowering an etching rate more, as compared to when gas except  $\text{CF}_4$  gas is used as the fluorine compound gas. By this method, an etching rate can be lowered, so that it is possible to achieve an effect of restraining variations of an etching depth even for a trench having  
15 a depth of about 100 nm.

Regarding the above, document 6 discloses that, in paragraph [0098] of specification, "a method of etching an object made of silicon using etching gas which includes  $\text{CF}_4$  gas and Ar gas".

However, document 6 does not disclose that by using  $\text{CF}_4$  gas  
20 as fluorine compound gas, the etching rate is lowered compared to when gas except  $\text{CF}_4$  gas, such as  $\text{SF}_6$ , is used as fluorine compound gas, in order to increase accuracy of the etching depth. Therefore, it is submitted that the present invention has novelty.